



Attorney Docket No. AM-8472

U.S. Express Mail No.: EV 095247262 US

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

IN RE APPLICATION OF: Sang H. Ahn et al.

§ GROUP ART UNIT: 1756

SERIAL NO.: 10/724,454

§

§

§ EXAMINER: D. Chacko Davis

FILED: November 28, 2003

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FOR: MAINTENANCE OF PHOTORESIST ADHESION  
AND ACTIVITY ON THE SURFACE OF DIELECTRIC  
ARCS FOR 90 nm FEATURE SIZES

§

§ Attorney Docket No.:

§ AM-8472

Date: October 31, 2005

**DECLARATION OF PRIOR INVENTION UNDER 37 CFR § 1.131**

Hon. Commissioner for Patents .  
P.O. Box 1450  
Alexandria, VA 22313-1450

Sir:

This Declaration under 37 CFR § 1.131 accompanies Amendment "A", which is in response to the Office Action mailed May 31, 2005.

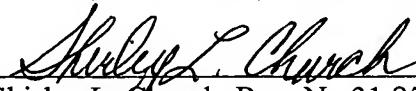
We, Sang H. Ahn and Sudha Rathi hereby declare that we and Heraldo L. Bothelho are joint inventors of the invention claimed in U.S. Patent Application Serial No. 10/724,454. We further declare that said invention was conceived and reduced to practice by us prior to November 6, 2003, which is the filing date of U.S. Patent Application Serial No. 10/702,049, which was published on May 12, 2005.

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**CERTIFICATE OF MAILING UNDER 37 CFR 1.10**

I hereby certify that this paper and any documents said to accompany this paper are being deposited with the U.S. Postal Service on the date shown below with sufficient postage as U.S. EXPRESS MAIL NO. EV 095247262 US in an envelope addressed to : Mail Stop Amendment , Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Date: October 31, 2004

  
Shirley L. Church, Reg. No.31,858

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Oct. 31, 2005 28AM DSM

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Attorney Docket No. AM-8472

U.S. Express Mail No.: EV 095247252 US

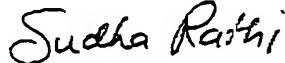
In support of our Declaration, attached is a copy of the Invention Alert which preceded the present patent application. This Invention Alert shows that the invention claimed in the present application was conceived and reduced to practice by us prior to November 6, 2003. Portions of the Invention Alert which pertain to conclusory dates of invention have been redacted to protect the rights of the inventors.

We, the undersigned, have been warned that willful false statements and the like are punishable by fine or imprisonment, or both, under Sec. 1001 of Title 18 of the United States Code, and further that such willful false statements and the like may jeopardize the validity of the application or document or any registration resulting therefrom, such as a patent issued thereon; and, each declarant declares that all statements made of his/her own knowledge are true; and that all statements made on information and belief are believed to be true.

1) Octo 31, 2005

  
\_\_\_\_\_  
Sang H. Ahn, Co-inventor

2) Octo 31, 2005

  
\_\_\_\_\_  
Sudha Rathi, Co-inventor

BcD

DSM



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## INVENTION ALERT FORM

Circle only ONE area of Technology  
Applicable to this Invention

AIT	AKT/TFT	CMP	CVET/CORP
DCVD	EMET	EPI/HTF	ESHO
HCVD	MCVD	MICR	HDP ETCH
PLAT	PVD	RTP	

MAY 09 2003

(Please use separate attachments for any answers that don't fit on this form, especially for questions 6-8. If the answer to a question is "none", please write "none" rather than leaving the answer blank.)

1.	Today's Date:	3/21/03
2.	Title of Invention:	Photoresist Poisoning Prevention and Photoresist Adhesion Improvement on DARC193
3.	Provide the following information of EACH inventor:	

### Inventor #1

Name:	Sang Ahn
Telephone:	408-986-7820
Job Title:	Process Engineer IV
Citizenship:	The Republic of Korea
Home Address:	720 Promontory Point Lane #2302, Foster City, CA 94404
Boss's Name:	Martin Seamons
Boss's Job Title:	Process Technology Manager for Lithography Films
His/Her Boss's Name:	Hichem M'saad
His/Her Boss's Job Title:	General Manager for Blanket Dielectric Film
Product Group:	Dielectric System and Module

### Inventor #2

Name:	Heraldo Botelho
Telephone:	408-235-6573
Job Title:	Process Engineer
Citizenship:	Brazil
Home Address:	1050 Borregas Ave, #26, Sunnyvale, CA
Boss's Name:	Mike Kwan
Boss's Job Title:	Technology Manager for Lithography Films
His/Her Boss's Name:	Hichem M'saad
His/Her Boss's Job Title:	General Manager
Product Group:	DSM

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Inventor #3

Name:	Sudha Rathi
Telephone:	
Job Title:	
Citizenship:	
Home Address:	
Boss's Name:	
Boss's Job Title:	
His/Her Boss's Name:	
His/Her Boss's Job Title:	

4. Earliest dates and model names of all Applied products incorporating the invention which have been offered for sale or are expected to be offered for sale

5. If invention has been demonstrated or described to persons other than Applied employees, for each disclosure please provide the earliest date, name of company, and brief description of what information was disclosed and purpose of the disclosures.

Infineon, IMEC,

Mixed frequency process PECVD process can eliminate 193nm photoresist poisoning, and scums by minimizing H<sub>2</sub>O absorption which results in -OH radical-related poisoning in 193nm photoresists. Moreover, adhesion between photoresist and DARC193 can be significantly improved by treating the DARC193 surface with H<sub>2</sub> or He. This disclosure is to promote and qualify DARC193 for the advanced process that utilizes DARC193.

Canon, 3/10/03; samples sent for PR adhesion eval.

ST, 3/21/03; samples sent for PR adhesion eval.

6. If disclosures as in question (4) are expected to occur within the next 12 months, please provide the anticipated date, type of information, and purpose of the disclosure.

Other customers as necessary

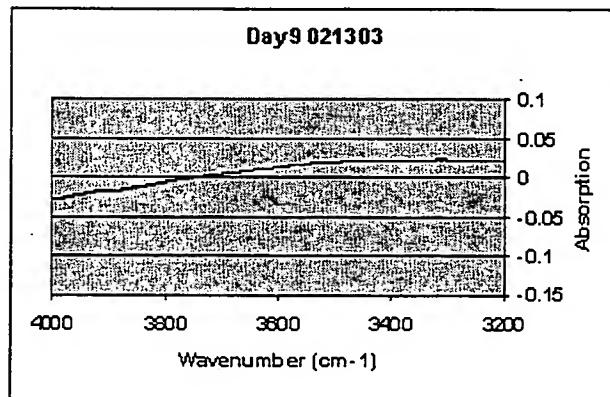
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7. Describe the invention, preferable with a reference to drawings.

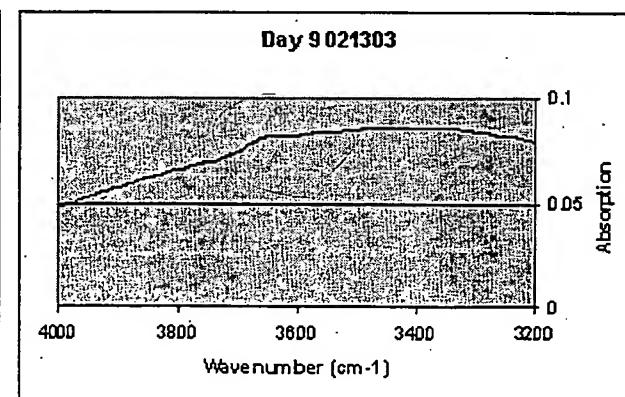
The use of a hydrogen treatment on top of DARC 193 to significantly increases the surface wetting angle, making the film hydrophobic. The H<sub>2</sub> treatment increases the wetting angle on a DARC 193 surface from 3.7° to 63.3°. This increase in wetting angle leads to an improvement in the adhesion between the DARC layer and a photoresist layer. In spite of a lesser increase in wetting angle, an amorphous silicon cap to DARC 193 also improved photoresist adhesion by increasing wetting angle from 3.7° to 34.5°. Wetting angle data measured at Applied Materials is shown on attached table. Hydrogen treatment was processed at 350°C, 5.5T, 450mils, 300W, 600sccm H<sub>2</sub> for 10sec on a twin-chamber Producer (V041B).

DARC	Treatment	RI & k	Contact
DARC	--	1.64/0.30	3.7°
DARC	CO <sub>2</sub>	1.64/0.30	3.5°
DARC	15Å α-Si	1.72/0.60	34.5°
DARC	25Å NF	1.64/0.27	3.2°
DARC	H <sub>2</sub>	1.64/0.30	63.3°
DARC	He	1.64/0.30	45.0°

DARC193 film is composed of SiOH with a trace amount of C. Precursors include SiH<sub>4</sub>, oxidizer, and if necessary, a carrier gas such as Helium or Argon. The plasma can be created with a high-frequency RF generator (Single Frequency, SF), or through a combination of HF and low-frequency RF generators (Mixed Frequency, MF). The use of the LF generator is beneficial in reducing the -OH absorption over time. The FTIR graphs below show a DARC film nine days after deposition. SF DARC shows a significant -OH absorption peak that is absent in the MF DARC FTIR.



MF DARC



SF DARC

In addition, oxidation resistance results are consistent with FTIR results, indicating that MF DARC193 is superior to SF DARC193 in chemical stability and robustness. (I attached the data)

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8.

List each feature of the invention which you consider novel and non-obvious. Describe the advantages of each novel feature in comparison with the state-of-the-art approaches which are closest to your invention.

The hydrogen treatment increases the photoresist adhesion to the DARC layer without adding an extra (cap) layer. This process is relatively fast (total process time: 30sec) and can be done in-situ if the process chamber has an H<sub>2</sub> line or ex-situ.

If hydrogen cannot be obtained, then an a-Si layer cap or He treatment can be a second alternative, since it can easily be accomplished in-situ on a DARC 193 chamber.

DARC193 can achieve great resistance to H<sub>2</sub>O absorption and O<sub>2</sub> ashing by adding LF power to the regular process recipe. This film does not require any oxidation treatment nor oxide cap.

9. Describe any other known designs, or processes, whether actually implemented or merely proposed in a publication, which could be considered similar to your invention or which constitute the state-of-the-art which your invention improved upon.

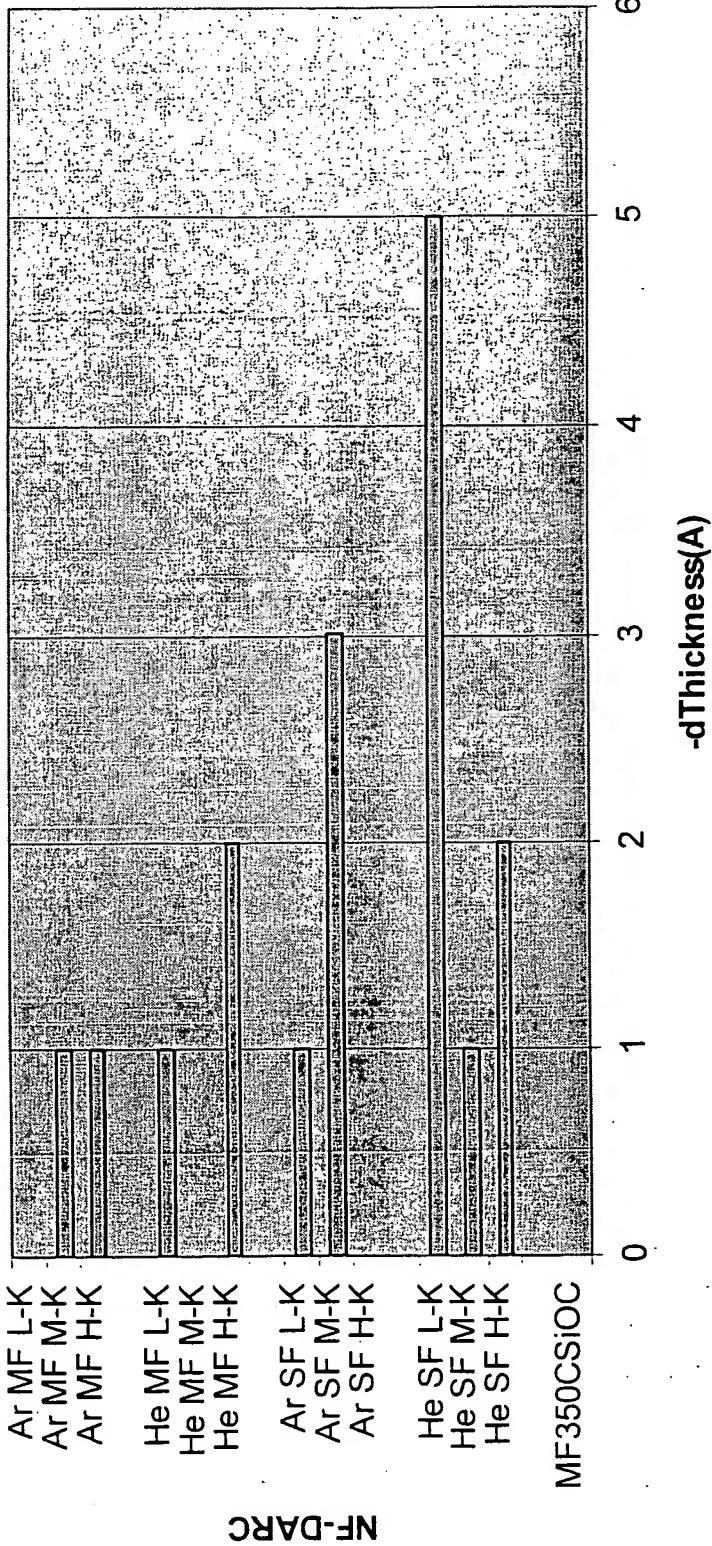
unknown

10. Signature, date, and printed name of each inventor plus two witnesses who have read and understood this Invention Alert Form.

<b>Inventor # 1:</b>	Date:
Sang Ahn	
Print Name	
<b>Inventor # 2:</b>	Date:
Heraldo Botelho	
Print Name	
<b>Inventor # 3:</b>	Date:
Sudha Rathi	
Print Name	
<b>Inventor # 4:</b>	Date:
Print Name	

# O<sub>2</sub> Ashing Resistance: Thickness

## Post O<sub>2</sub> Ashing Reduction in Thickness

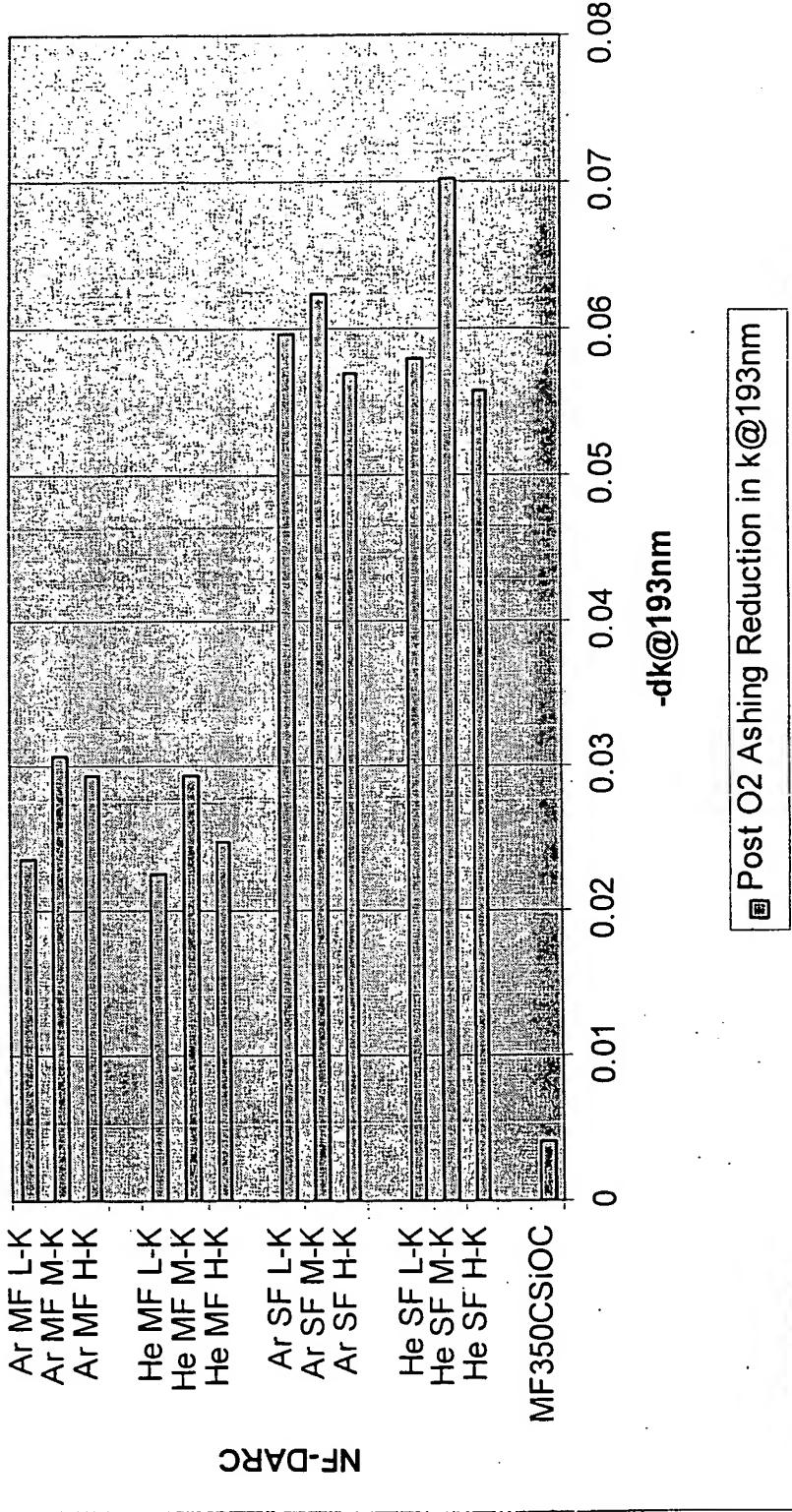


■ Post O<sub>2</sub> Ashing Reduction in Thickness

MF DARC shows better resistance to O<sub>2</sub> ashing

# O2 Ashing Resistance: k@193nm

## Post O2 Ashing Reduction in k@193nm

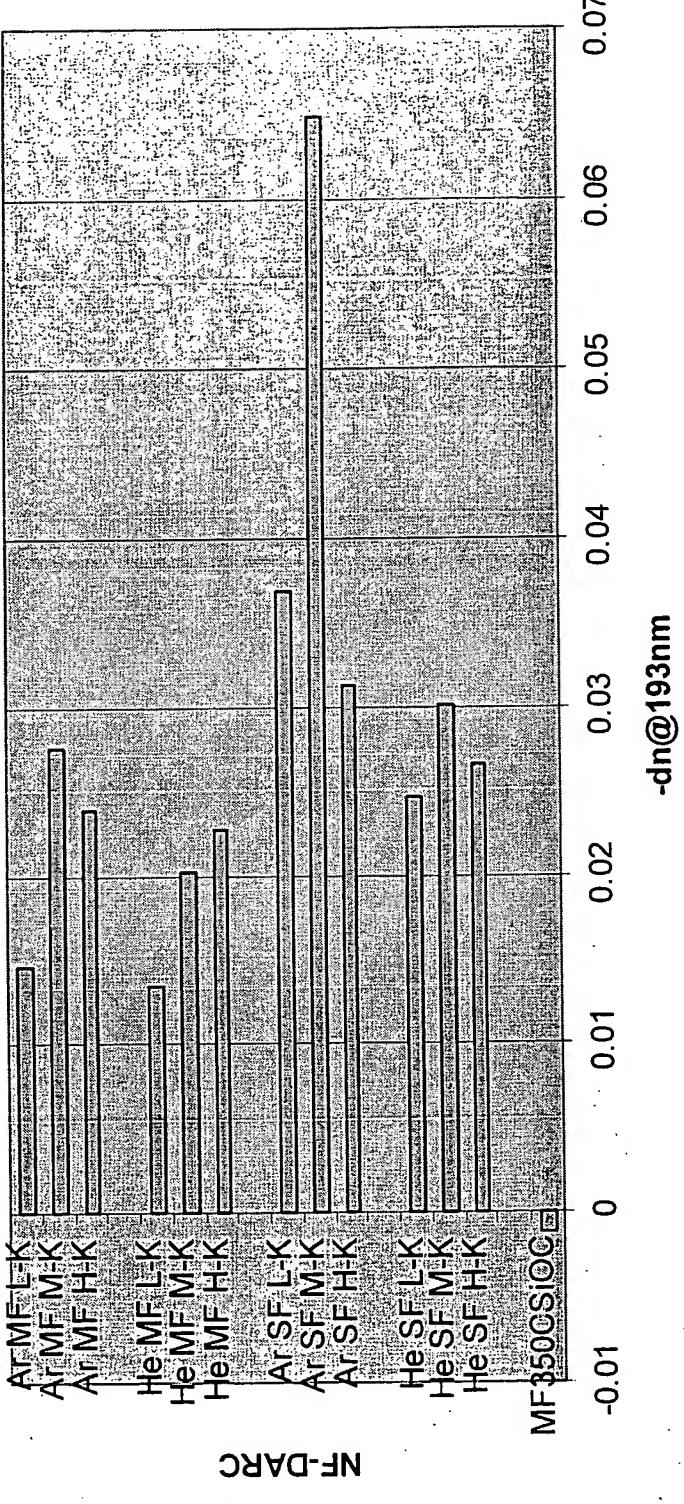


**MF DARC shows 2x better resistance than SF. The slower the deposition  
The better the resistance.**

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# O2 Ashing Resistance: n@193nm

## Post O2 Ashing Reduction in n@193nm



■ Post Ashing Reduction in n@193nm

-dn@193nm

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